# System for and Method of Printing from a Digital Camera Image Proof Sheet

## Technical Field

The present invention relates to methods of and apparatus for use in digital photography.

## Background Art

Advances in digital imaging as well as the availability of inexpensive high-density solid-state memory have brought about a revolution in photography. Mid to high-end digital still cameras (DSCs) now offer resolutions which, when printed using a high quality laser or inkjet printer, approach that of conventional darkroom techniques. As this type of photography has developed and gained popularity, new and innovative multimedia solutions have been developed to meet consumer needs for storage, display and manipulation of graphical images.

It has long been possible to scan standard conventionally produced photographic images in order to digitally manipulate, transmit and store them. However, the move to pure digital image recording of images raises significant obstacles to the widespread acceptance of digital photography. These obstacles include the perceived difficulty involved in uploading digital images from the DSC to the viewing platform or to a printing device. A viewing platform will usually be a personal computer (PC), but it may be a personal digital assistant (PDA), tablet computer, hybrid or other type of display device.

Various solutions for image manipulation and printing exist in the marketplace. These include the use of proprietary data transfer standards whereby a direct cable connection is established between the DCS and the viewing platform in order to upload the images. The stored images can then be manipulated using a graphics program such as Adobe Photoshop™ and printed.

This process can be slow and fraught with problems stemming from the need to configure a data link between the DCS and the viewing platform as well as the relative complexity of many image manipulation programs.

Although known digital image applications can be extremely powerful, the complexity of the image manipulation software can be daunting, as often most consumers only require a limited subset of the functionality of a typical package. This explains to some extent the coexistence of software packages that range from highly sophisticated image manipulation environments to very basic image selecting, viewing, cropping and printing packages.

Notwithstanding the availability of relatively simple image manipulation packages, the upload and management of digital images can be problematic. This is exacerbated by the ease with which digital images can be recorded. Unlike conventional photography, there is no film to consume and with increased memory capacities, it is common to take a large number of images of widely varying quality and subject matter. Further, many DSC models have automatic exposure bracketing and sequential image functionality. This can lead to the retention of even larger numbers of images.

It is therefore sometimes impractical to upload and/or print every one out. Some images may be of poor quality, duplicates or of no interest. Managing a large number of image files on a personal computer can also be complicated and time-consuming, particularly if some are to be viewed, compared and/or discarded. Present techniques also require that a viewing platform of some type be used.

An object of the invention is to provide a new improved method of and apparatus for previewing, manipulating and printing digital images, wherein the method and apparatus are modeled on the print-based tasks normally associated with traditional silver-halide photography techniques.

One solution which goes some way toward solving this problem is exemplified by the copending, commonly assigned US application serial number US 2002/0033965 A1 entitled "System and Method for Printing and Scanning a User-Completed Digital Still Camera Image Proof Sheet and Order Form".

The system and method disclosed in that application provide a user-friendly data interchange methodology whereby solid-state memory cards used in DSCs, such as SD, MMC and Flash Memory, can be plugged directly into a printer.

Plugging the memory cards directly into a printer avoids the need to upload the digital images using any direct physical connection. The user records the images using a DSC having such a card (or other removable media), removes the card from the camera and inserts it into the corresponding slot on the printer.

The printer is configured to provide a simplified display interface which includes a proof-sheet printing function. The user prints out and writes user-applied indicia, or "markups", on the proof sheet and feeds it back through the printer. The printer, operating as a scanner, then images and interprets the marked up proof-sheet and prints the desired images with any corrections or modifications as specified by the user-applied indicia.

This technique therefore mimics the steps in conventional photographic techniques, primarily in the context of treating the memory card like a roll of film and the proof-sheet as an order-form which specifies how the 'film' is to be printed.
This technique does have limitations in that the complexity of image manipulation is limited by the scanners "vocabulary" in terms of marking images for printing and cropping and adjusting various image characteristics. It is also constrained to some extent by the requirement that the printer be able to scan the proof-sheet at a specified level of accuracy. While this may be acceptable for high-end printers where sometimes the printer incorporates scanning functionality anyway, it may be cost-prohibitive for

low-end consumer printer units which need to be simple and inexpensive to manufacture. Also, it has been found that scanning methods have usability difficulties such as inadvertent mis-scanning of the proofsheet.

One other solution which partially addresses the aforementioned problems exists in the form of International Patent Application no WO 00/72237A1. However this disclosure is focused primarily on using a paper-based network interface to design and build online photo-albums. Some manipulation functionality is described; however the techniques remain relatively complex and do not attempt to replicate established techniques for review and printing of photographic images. In particular, the Netpage™ technology of applicant's assignee is adapted to provide what is essentially a file management interface where conventional image manipulation commands are input via optically enabled position sensitive paper. The techniques described in WO 00/72237A1 also involve repeated printing and updating of image layouts and the associated pen command interface areas on the printed netpage. Such a technique, while being suitable for the more sophisticated user, is likely to be inaccessible to a consumer-level user. A further complexity is that the system described in the '237 A1 document requires two-pass printing to superimpose image and command information over the top of the position data array so that an infra-red sensitive pen can read the pen position even when marking up regions obscured by human visible areas.

Thus it would be a significant advantage if the conventionally-based photographic printing steps could be carried out, but at the same time allowing more freedom and flexibility in how a proof-sheet is marked up and the image manipulation information is communicated to the printer. It remains important to preserve the computer-independent approach, keep the system simple and, where possible, reflect the conventional techniques of conventional print photography. It is also important that the techniques be capable of implementation on legacy hardware with little or no hardware modification and in a way which enhances the users photographic experience in an intuitive and productive way.

Another object of the invention is to provide a new and improved system for and method of enabling a user to easily manipulate and print images taken using a digital still camera (DSC) using neither a personal computer nor a complex graphics manipulation interface.

A further object of the invention is to provide a system for and method of enabling a user to review, manipulate and print digital images.

**Disclosure of the Invention**

In one aspect, the invention provides a method of manipulating digitally stored images, the method including the steps of:

recording and storing digital representations of one or more images;

transferring one or more of the plurality of digital images to a printer capable of generating representations of selected ones of the plurality of images;

generating, with the printer, a proof-sheet incorporating a graphical representation of at least one of the images and a plurality of image selection and/or image manipulation user designation areas, wherein the proof-sheet is adapted to contain location information which identifies physical spatial locations on the surface of the proof-sheet;

the user applying user-applied indicia to at least one of the user designation areas on the proof-sheet using a pen adapted to record the location of the indicia on the proof-sheet; and

transmitting data relating to the location of the indicia to the printer from the pen whereby the printer translates the data into printing and/or image manipulation commands.

Preferably the location information which identifies physical spatial locations on the surface of the proof-sheet is arranged so as not to optically interfere with the one or more images and/or the image selection and/or image manipulation user designation areas.

Preferably, the method includes the step of printing the one or more images based on said indicia spatial location information data.

In a preferred embodiment, the one or more images are stored on read/write capable media and the printer receives the media therein reads the data stored thereon.

Preferably the paper incorporates a plurality of glyphs that provide position information to the pen and said position information is communicated to the printer. Preferably the position information is provided to the pen optically.

In an alternative embodiment, the absolute position of the pen may be detected using a position location system based on infra-red detection, electromagnetic spatial orientation or the like.

In a preferred embodiment, the position of the user-applied indicia are thus recorded by optically imaging the glyphs at the time that the indicia are applied.

Data related to the position of the user-applied indicia are recorded by the pen, then transmitted to the printer.

Alternatively, the data relating to the position of the user-applied indicia are transmitted to the printer substantially continuously, buffered for transmission or otherwise streamed.

The data relating to the position of the user-applied indicia are preferably transmitted using a wireless communication link.

In a less preferred embodiment, the data is transmitted via a cable, optical or similar link.

In a preferred embodiment, the data is transmitted to the printer at the instigation of the user, preferably by the user activating a switch or a sensor on the pen.

The invention also provides a printing system including:

a printer adapted to receive image data relating to one or more digital images taken by a user, the printer further adapted to produce a proof-sheet detailing the graphical images; and

a pen, wherein the paper and pen are adapted so that user-applied indicia corresponding to image manipulation commands which are adapted to be applied by the user to the proof-sheet can be transmitted to the printer by recording the spatial position of the user-applied indicia on the proof-sheet and transmitting same to the printer.

The pen is preferably adapted to image a glyph pattern which provides a unique optical pattern for any point on the proof-sheet, for allowing the pen and thus the position of the indices to be located on the proof-sheet.

**Brief Description of the Drawings**

The present invention will now be described by way of example only and with reference to the drawings in which:

Figure 1: is a simplified schematic diagram of a system for transferring digital images to a printer from a digital still camera (DSC);

Figure 2: is a simplified schematic diagram of a printer adapted to receive digital spatial position information;

Figure 3: is a diagram of apparatus for performing the process of marking up a proof-sheet with an optical position sensing pen and the transmitting position data to a printer;

Figure 4: is an enlarged diagram of a user-designated area on a proof-sheet;

Figure 5: is an illustration of an exemplary proof-sheet with user-applied indicia; and

Figure 6: is a flow diagram of a method of manipulating digital images via a proof-sheet.

**Detailed Description of the Drawing**

Figure 1 is a simplified schematic diagram of a system for transferring digital images from a digital still camera (DSC) 11 to a printer 10. This transfer is achieved without using an intervening viewing or transfer platform such as a personal computer. Details of this process can be found in the commonly assigned copending application US 2002/0033965 A1 the disclosure of which is herein incorporated by reference. Various mechanisms can be used for transferring the image data. These include physically plugging a DSC memory card 12 into the printer 11, using a floppy disk 13 to transfer the files or transmitting them via an infra-red or RF link 14. For completeness, data transfer via a physical hardwired cable or camera connection 15 is also shown. A preferred arrangement is to use removable storage media which is initially connected to the DSC and then, physically moved to the printer. For example, the printer can incorporate a Compact Flash (CF) card reader so that a CF card resident in the camera can be simply inserted into the printer reader. This approach avoids using cables and to a degree mimics the "film roll" photography paradigm of exposing a roll of film on an outing and removing it from the camera for processing.

Figure 2 is a functional schematic diagram of a printer having a core component incorporating a central processing unit (CPU) 20 and a print engine 25. The CPU 20 coordinates the functions of the printer including transferring image data from removable memory 12 via the memory card reader 22, to the RAM 24 for subsequent handling and printing.

The print engine 25 includes media handling hardware, a print head and other components found in a variety of printers. The construction and operation of such components is known to one skilled in the art and, for brevity, is not discussed in detail, except where necessary to illustrate operation of the illustrated system.

The CPU 20 is connected to a display and interface unit 21 which acts as an enunciator panel to transmit the printer state and command results to the user. Unit 21 may be an LCD display with a menu interface. A number of display and interface approaches are possible depending on the level of sophistication of the printer and the complexity of the functions of the printer. The printer of Fig. 2 can also be a consumer-level device with no display. This would lead to reduced manufacturing costs and further extend the notion of a very simple digital photograph selection and printing system.

The printer of Fig. 2 also includes a receiver 23. Receiver 23 is adapted to receive image manipulation data in the form of spatial location data corresponding to the position of the user-applied indicia drawn by a user on proof-sheet 40, Figure 5. The receiver 23 is preferably an RF unit 23 connected to the CPU 20. Receiver 23 typically conforms to the Blue Tooth or other wireless data connectivity standard.

Figure 3 is an illustration that assists in describing the operation of the apparatus of Figs. 1 and 2. Printer 10 in Fig. 3 is configured generally as shown in Figure 2 and the system operates as follows.

The user wishes to manipulate images which are digitally recorded then stored in the memory card 12. Manipulation is understood to mean selecting particular images for printing, cropping, enhancing and specifying the number of copies to be printed. Other manipulation functions are possible. The complexity of these functions depends on the target user and it is anticipated that at a consumer level, core functions such as those described above are provided. More sophisticated functionality, such as color balance, batch image manipulation and the like can be provided. The invention is flexible in this regard as different user designation areas can be configured to correspond to virtually any printer function.

The first step is for the user to record and store digital representations of one or more images on a DSC 11. This can be done with any compatible camera. The images are then transferred in a known manner from DSC 11 to a printer 10 capable of generating hardcopy representations of selected ones of the plurality of images which the user has transferred.

The user then operates the printer 10 to generate a proof-sheet 40. The proof-sheet 40 is adapted to incorporate a graphical representation 36 of at least one of the transferred images as well as a plurality of image selection and/or image manipulation user designation areas 42. The proof-sheet is further is adapted to contain location information glyphs 41, Figure 4, which identifies any physical spatial location on the surface of the proof-sheet 40.

Once the proof-sheet 40 is printed, the user draws indicia ("markups") 43 on at least one of the user designation areas 36, 42 on the proof-sheet 40 using a pen 30 adapted to record the spatial location of the indicia 43 on the proof-sheet 40.

An exemplary proof-sheet 40 including user-applied indicia is shown in Figure 5. The proof-sheet, as illustrated in Fig. 5, includes six images 36 and incorporates a set of relatively simple user designation areas which correspond to the selection of one or more of any image for printing, brightness enhancement and cropping function. As can be seen from Figures 4 and 5, the user marks up the proof-sheet 40 using a specially adapted pen 30 which records the position of the user-applied indicia on the page relative to location information glyphs 41.

To allow the system to interpret the user-applied indicia in an intuitive and natural way, the proof-sheet paper 40 has printed thereon a plurality of glyphs 41 which are adapted to provide position information to pen 30. When the user marks up the proof-sheet, he or she simply writes on the proof-sheet as one would when marking up a standard photographic proof-sheet. However, the pen 30 is built so that whenever it applies ink to

sheet 40, the pen images the glyphs on the paper comprising sheet 40. The patterns of glyphs 41 within the field of view of pen 30 are unique for any location on the proof-sheet 40. As pen 30 moves across the paper comprising sheet 40, the pen images the glyphs 41 thereby providing spatial location data which can then be correlated with the function of the user designation area 42 and thus be acted on by the printer 10. It is not necessary or, in fact, desirable that the pen 30 image or record the ink marks 43 applied by the user. All that is required is the position information corresponding to where on the proof-sheet the user applied the markups.

In a preferred embodiment the ink used in the pen and visible to the user is transparent to an optical imaging system of pen 30 while the ink used to form the glyphs on the proof-sheet is visible to the imaging system of the pen. Thus the user can ostensibly obscure the glyphs 41 by marking up the proof-sheet while the pen 30 continues to record the position of the user-applied indicia anywhere on the page.

Details of how glyph patterns 41 may be decoded to specify a unique position on the proof-sheet 40 can be found in US patent 6,208,771 assigned to Xerox PARC, the disclosure of which is herein incorporated by reference.

The spatial location of the indicia 43 is then transmitted to the printer 10. Printer 10 is adapted to translate the indicia 43 spatial location into printing and/or image manipulation commands. This translation is possible as the printer 10 intelligence is adapted to correlate the characteristics or meaning of the user designation areas on the proof-sheet. For example, the user has selected two copies of image number two on Figure 5, have enhanced brightness (on a five-increment scale). The user has also specified a certain amount of cropping of image number two, as indicated by the lines and hatched areas on the images.

In this example, using the specially adapted pen 30 and proof-sheet 40 combination, the pen records the locations of the user-applied indicia and transmits the recorded locations

to the printer 11. The printer 11 interprets the location information of the indices and correlates the position of the indicia with print commands. Thus the "2" in the print number box is converted into position data located within the boundary of the user designation area indicated by the box and further recognized as the numeral "2". To this end the pen or the printer preferably includes optical character recognition (OCR) capability to enable it to correctly interpret the users input. However, where the position of the indicia is the sole determinant of the function, OCR is not necessary. Similarly, the selected brightness indicia are converted to position information for that specific user designation area and thus the printer 10"knows" that the image is to have its brightness enhanced. Cropping information is collected and interpreted similarly.

Once the location of the indicia is transferred to the printer 10, the printer prints the corresponding images based on the spatial location information.

The system and method are particularly advantageous as the user designation areas may be configured so that overprinting of the human-readable information does not interfere with the pen-readable information. As can be seen, the user designation areas are selected so that the system always has sufficient information to interpolate between user designation areas in the case of cropping where the user-applied line passes through the image. Also, the manipulation areas need only be marked somewhere within their boundaries to record the fact of a user's designation of that area. Thus, there is no need to print the proof-sheet 40 in a double pass, the first applying the IR visible position information and the second the human-readable ink. Both may be applied at once. Also, it is feasible that the position information could be applied using the same technology as the image information. This is due to the realization that only relatively low position resolutions are needed, given the particular requirements of a useful proof-sheet production system. In order to mimic proof-sheet functionality it is not necessary to provide full character recognition or extremely high resolution pen location. The intuitive way in which a photographer marks up a proof-sheet is almost necessarily low

in machine-level accuracy. What is required is flexibility, low expense, speed and a flexible, easily learnt interface.

Thus, the system and method provide a substantial advantage in that a fully functioning consumer-level integrated print-station can be manufactured without special print technology or multiple inks. The commercial embodiment of the system and method can therefore be manufactured relatively inexpensively and provided at an accessible cost to the home photographer.

In an alternative, less preferred, embodiment, the absolute position of the pen 30 can be detected using a position location system based on infra-red detection, electromagnetic spatial orientation or the like.

As noted above, once the data related to the position of the user-applied indicia is recorded by the pen, it is transmitted to the printer. The wireless communication system can be based on the Blue Tooth standard and the timing and sequence of data transfer can be configured according to the user's or manufacturer's preferred method. To this end, the data relating to the position of the user-applied indicia can be transmitted to the printer continuously. Using this method, as the user marks up the proof-sheet, indicia position information is continuously streamed to the printer via the wireless link.

However, a more preferred system is where the user periodically transmits the data to the printer. For example this might be done after a particular sequence of markups have been applied. According to another method, the data can be continuously stored and/or interpreted by the printer. Once the user has triggered a completion command, the printer parses the user-applied indicia position information and converts this into commands for manipulating and printing the images.

The data transfer from the pen to the printer can be triggered using a switch mounted on the pen. Other data/command transfer paradigms are possible including the user periodically

ticking a "data send" designated area on the proof-sheet. Alternatively, the printer can poll the pen for this initiation signal whereupon the previously buffered information is acted on. As noted above, in the preferred embodiment, the data is transmitted to the printer at the instigation of the user as this allows the user to mark up the proof-sheet intuitively and in a manner similar to that used in conventional proof-sheet markup.

The glyph pattern is distinctive with the glyphs being positioned according to a predefined algorithm (see US 6,208,771). Therefore the position encoding information must be printed accordingly. This can be done by storing a bitmap of a glyph background in RAM and printing this bitmap as a background when the proof-sheet is printed. Alternatively, the glyph background can be calculated on the fly and printed concurrently with the proof-sheet images and user designated areas.

An interpreter module (not shown) in the printer controls what actions are taken in response to marking specific user-designated areas on the proof-sheet. The module is in the form of firmware stored in an EEPROM. Thus a certain proof-sheet generating application or application version can use a specified proof-sheet layout with the corresponding mappings between designation areas on the sheet with image control functionality. The interpreter can be configured to operate by determining boundary requirements for user-applied information. Certain areas of the proof-sheet can be correlated with specific functions or image manipulation processes and so the interpreter need only recognize the location of the markup on the page and there will generally be no need to decode data embedded into the background location information.

A development toolkit can be used to allow the more sophisticated user to configure specific proof-sheet formats and functions. The toolkit can be an interactive simplified menu on the printer whereby one of a pre-configured proof-sheet format could be selected. Alternatively, the toolkit may be in the form of a PC application which could upload the proof-sheet format to the printer.

A further aspect of the invention includes providing specific image processing functionality within the printer. Many third party image manipulation packages include pre-configured filters which can be used to output black and white, sepia or various colour enhancements. The invention contemplates a printer preconfigured with such functionality where these operations are triggered by the user-applied markups on the proof-sheet. Again a development toolkit can be used to develop specific filters of image processing functions which are then uploaded to the printer and selected as a printer mode via the 'paper-interface'. This closely mimics the established "workflow" approach followed by both print and digital photographers whereby a series of specific steps are followed in processing raw images downloaded from a DSC. These processes are often configured to run on a PC as a batch process via an image processing application front-end. The present invention provides a method of and apparatus for extending the functionality of the proof-sheet approach to allow batch processing to be programmed into a printer.

This functionality is useful in situations where a vendor wishes to provide a consumer printer with a number of built-in functions such as sepia toning, panorama output and other artistic effects which normally have to be carried out via an image processing application.

To this end, the functionality of the integrated printer and proof-sheet application and proof-sheet layout can be changed or upgraded by reflashing the EEPROM in the printer core module. Reflashing provides a substantial advantage as it generally avoids the need to manufacture multiple hardware configurations corresponding to different proof-sheet printing and interpretation functionality. For example, a consumer-level printer may have a more limited set of markup options than the set of markup options for a commercial printer. Of course, hardware changes may be desired where a range of print features or qualities are needed. However, it is envisaged that the method and system may be provided across a variety of user environment complexity levels without requiring anything more than a different printer BIOS and/or glyph bitmaps or glyph generation engines.

It is also anticipated that some of the image processing functionality previously used in the context of the viewing platform (personal computer or otherwise), can be integrated into the printer's intelligence. With increases in processing power of processor chips and visual processing units coupled with less expensive memory, more image processing functions can be included. These increases in processing power would be limited only by their amenability to command interaction via user-applied indices (markups) on the printed proof-sheet. However, as noted above, complexity in image manipulation can be accommodated within the accuracy of the invention, using more complicated and detailed user-designation areas on the proof-sheet.

The invention provides a highly intuitive system for printing a proof-sheet (or "order-form") which allows a user to manually mark up portions of the proof-sheet with image selection and manipulation commands. The resulting system can be built in production quantities relatively simply and inexpensively. No substantial additional hardware is required for the printer apart from a wireless receiver and its support hardware. With the cost of such receivers dropping significantly, it is anticipated that the invention will be commercially cost effective and have great appeal to consumers and professionals alike.

Although the invention has been described by way of example and with reference to particular embodiments it is to be understood that modification and/or improvements may be made without departing from the scope of the appended claims.